Measuring coping style following acquired brain injury: a modification of the Coping Inventory for Stressful Situations using Rasch analysis.

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Abstract

Objective: The importance of coping style factors in the process of emotional adjustment following acquired brain injury (ABI) has been gaining increased attention. To assess ways of coping with distress accurately, clear conceptual definitions and measurement precision is vital. The purpose of this study was to investigate the psychometric properties of a well-known measure of coping, the Coping Inventory for Stressful Situations (CISS), for people who have experienced an ABI; and to modify the CISS, where necessary, to create a more reliable and valid measurement tool for this clinical group.

Methods: Psychometric properties were investigated using Rasch analysis of responses from a sample of adults with ABI (n = 207). The internal consistency reliability and construct validity of the scale were examined.

Results: All originally proposed subscales were not valid or reliable and, as such, were incapable of interval-level measurement (Task: χ^2 (32, N = 207) = 105.1, $p < .001$; Emotion: χ^2 (32, N = 204) = 121.9, $p < .001$; Avoidance: χ^2 (32, N = 207) = 66.7, $p < .001$). Three valid and reliable subscales were derived measuring emotion-, task- and avoidance-oriented coping styles by removing items that provided the most unreliable information and exploring fit to the Rasch model.

Conclusions: The original version of the CISS is not a valid and reliable measure of coping style following acquired brain injury. Modified subscales of the three distinct coping domains have been proposed that would improve measurement of coping style following ABI in future research and clinical practice.

Key words: *Coping style, Acquired Brain Injury, Psychometrics, Rasch Analysis*

Practioner points

- How people cope with difficulties following an acquired brain injury has been shown to impact upon emotional outcomes and functional recovery.
- The original version of the Coping Inventory for Stressful Situations was found to be an imprecise measure of coping following acquired brain injury.
- A modified version of the coping inventory for stressful situations was found to be a valid and reliable measure of three styles of coping (task-focused, emotion-focused and avoidance-focused) that conforms to the properties of interval-level measurement as represented by the Rasch model. This structure is in-keeping with previous theoretical models of coping.
- We advise caution about including items (1, 6, 7, 22, 24, 28, 29, 33, 34 and 46) that were found to diverge from the expectations of the Rasch measurement model in total subscale scores for measuring change in coping style.
- A conversion table for the three modified subscales is included in this paper to convert total raw scores into Rasch transformed logit values.
- Identifying strengths and weaknesses in coping style could be a means of guiding psychological intervention to promote good recovery following acquired brain injury.
- The sample included mainly people who had experienced non-traumatic brain injuries (e.g. a stroke).
- This research could be extended to include broader sample of people with differing brain injury aetiologies and neurological disorders.

Introduction

Acquired brain injury (ABI) refers to any non-progressive brain injury that occurs following birth and includes brain injuries that result from head trauma (known as traumatic brain injury) and cerebrovascular accidents (or strokes), as well as less frequent aetiologies such as brain tumours, infections of the brain and hydrocephalus. The role in which styles of coping play in the process of recovery following ABI has gained increasing attention during recent years because of the evidence that certain coping styles can facilitate or impede emotional adjustment during times of stress. Three main distinctions consistently appear within the literature: problem-focused, defined by Lazarus and Folkman (1984; p. 150) as 'coping that is aimed at managing or altering the problem causing the distress'; emotion-focused, also defined by Lazarus and Folkman (1984; p. 150) as 'coping that is directed at regulating the emotional response to the problem'; and avoidance-focused coping, defined by Endler & Parker (1999; p. 33) as engaging in 'activities and cognitive changes aimed at avoiding the stressful situation', including 'distracting oneself with other situations' or 'social diversion'. Greater reliance on emotion-focused and avoidance-focused coping, and lack of problem-focused coping, has been associated with poor emotional adjustment, including psychosocial dysfunction, lower levels of self-esteem and higher levels of depression, anxiety, post-traumatic stress, apathy and denial (Anson & Ponsford, 2006a; Bryant, Marosszeky, Crooks, Baguley & Gurka, 2000; Finset & Andersson, 2000; Kortte, Wegener & Chwalisz, 2003; Riley, Dennis & Powell, 2010). In contrast, greater use of problem-focused coping, and less use of emotion-focused and avoidance-focused coping, has been associated with better outcomes, including improved health-related quality of life, psychosocial functioning and return to employment (Anson & Ponsford, 2006a; Clarke & Black, 2005; Malia, Powell & Torode, 1995; Tomberg, Toomela, Pulver & Tikk, 2005). Research has

begun to explore the potential of teaching coping skills as a means of improving emotional adjustment following ABI, with mixed results but some initial positive findings (Anson & Ponsford, 2006b; Backhaus, Ibarra, Klyce, Trexler & Malec, 2010; Wolters, Stapert, Brands & van Heugten, 2010).

Measurement of coping style

Coping style following ABI has been assessed through a variety of mediums, including neuropsychological tests (Krpan, Stuss & Anderson, 2011b) and virtual reality tasks (Mendozzi, Motta, Barbieri, Alpini & Pugnetti, 1998). However, by far the most common method of assessment is via self-report. A number of self-report measures exist and have been employed to assess coping style following ABI. However, the psychometric properties of these self-report measures are under-reported and, if reported, relatively poor, calling into question the validity and reliability of many of these measures (see Donnellan, Hevey, Hickey & O'Neil, 2006; and Wolters, Brands, Stapert, Verhey & van Heugten, 2014, for reviews of measures used to assess coping style after stroke and other ABIs). Of the other measures of coping that exist and have been used most frequently with ABI research, Wolters et al identify the brief COPE (Carver, 1997), the Coping Scale for Adults-short form (Frydenberg & Lewis, 1997), and the Utrecht Coping List (Schreurs, van de Willege, Brosschot, Tellegen & Graus, 1993) as those with the best psychometric properties for this clinical population but state that further validation of tools for assessing coping styles will be important for further research.

The Coping Inventory for Stressful Situations

The Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990) is an alternative 48-item scale that was developed to measure the three styles of coping described earlier in the paper: task-oriented (equivalent to problem-focused), emotion-oriented and avoidance-orientated coping (sometimes separated into social diversion and distraction). A substantial amount of work has already been carried out to validate this measure and it has been found to have a robust dimensional structure amongst a variety of populations (Amarneh, 2002; Cook & Heppner, 1997; Cosway, Endler, Sadler & Deary, 2007; Endler & Parker, 1994; Han, Burns, Weed, Hatchett & Kurokawa, 2009; Hurt et al., 2010; McWilliams, Cox & Enns, 2003), including, most recently, within a sample of people who had experienced an ABI (Brands, Köhler, Stapert, Wade & van Heugten, 2014) and the three-factor structure originally suggested by Endler and Parker has been consistently supported.

Despite displaying good psychometric properties in a variety of different populations, the CISS has rarely been used to measure coping style following ABI, perhaps because, until recently (Brands, Köhler, Stapert, Wade & van Heugten, 2014), it had not been validated for use within this population. This recent paper highlighted that some items might be unreliable indicators of coping style amongst people who have experienced an ABI. Reasons such as high prevalence of cognitive deficits and poor mobility along with language and communication deficits have been put forward as reasons why self report measures of coping may need to be specifically designed or adapted for use with people who have experienced an ABI (Wolters, Brands, Stapert, Verhey & van Heugten, 2014).

Therefore, the analysis reported in this paper sought to investigate the properties of individual items included in the CISS to develop a more valid and reliable measure of coping

style following ABI. Advances in psychometric theory support the use of methods using the Rasch measurement model (Rasch analysis) for investigating psychometric properties of self-report tools at an item-level, over and above the use of more traditional psychometric methods for evaluating scales (see Hobart & Cano, 2009). Indeed, a major criticism of existing coping measures is that they have been developed using classical methods such as exploratory factor analyses, which may be inappropriate for designing measures of constructs involving a high degree of variability and lead to inconsistency in measurement (see de Ridder, 1997). In this study Rasch analysis was carried out to achieve a better understanding of how the CISS functions as a measure of coping style following ABI. Of particular interest was the construct validity of the measure and if all items were precise and reliable quantifiers of coping in relation to ongoing daily hassles.

Methods

Measures

All participants completed the 48-item Coping Inventory for Stressful Situations (CISS; Endler & Parker, 1990), which is made up of three 16-item subscales measuring three distinct styles of coping: problem-focused, emotion-focused and avoidance-focused coping. Each item is made up of five response categories representing the degree to which someone engages in a specific coping strategy with each coping style domain, ranging from ‘not at all’ to ‘very much’.

Procedures

The CISS measure was administered face-to-face, with the help of a researcher. Participants were told that their answers would help to gain a better understanding of how people

who have experienced an ABI cope with emotional distress. They were asked to think about how they coped with stressful situations in relation to general daily hassles rather than a specific event.

Participants

Data from two studies investigating coping style following ABI were collated for this analysis (n = 207). Both studies explored emotional adjustment following ABI. Study 1 exclusively focused on the experiences of a sample of people who had suffered a stroke and study 2 included a sample of people with mixed ABI aetiologies. Participants included in study 2 were all reporting problems with memory or planning impairments as a result of their brain injury. Demographic information about the present sample can be found in Table 1, including mean age and time post injury, along with proportions of people belonging to gender and aetiological groups.

Ethical Approval

All participants gave informed consent for their responses to the CISS to be analysed as part of research and ethical approval for this analysis was granted by the local NHS ethics committee. Research governance was overseen by the research and development department within the appropriate NHS Trust.

********** Table 1 **********

Data analysis

Rasch analysis was performed on the responses to the CISS, as a whole and on subscales proposed in the previous literature (Task, Emotion and Avoidance-focused coping styles), including the short versions of these subscales proposed by Endler and Parker (1994), using the software package RUMM2020 (Andrich, Sheridan & Lou, 2005), and following guidelines for reporting Rasch analysis (Smith, Linacre & Smith, 2006; Tennant & Conaghan, 2007). Responses to the CISS that included missing data were retained in the analysis. However, the frequency of missing data for each individual item was evaluated as useful additional information about the feasibility of the item.

Construct validity

The construct validity of the measure, as a whole, was assessed by comparing the observed pattern of responses to the pattern expected by the partial credit Rasch measurement model. This analysis follows an item-response theory (IRT) approach as opposed to classical test theory methods. The main difference being that the IRT approach does not assume that all items in a self-report tool contribute equally to the measurement of a construct and takes account of these item-level differences within the analysis.

If the observed pattern of responses did not significantly deviate from the pattern of responses expected by Rasch model, the scale was assumed to have interval-level measurement properties. Further tests were carried out to assess whether the assumptions of unidimensionality were met, following the guidelines set out by Smith (2002). This process was repeated for the measure divided into the subscales put forward by Endler and Parker (1990). In addition to investigating the construct validity of the scales, tests were carried out to establish the level of reliability or internal consistency of items in the scales, as measured by the 'person separation index' (PSI).

Following on from this analysis, if the scale(s) did not meet the assumptions of the Rasch measurement model, further investigation was carried out to identify modifications that could improve the measurement properties of the scale(s). This included a detailed exploration of the pattern of responding to each individual item and by each individual respondent to identify items or persons in the sample that may be contributing to 'unpredictable', and thus unreliable, responding. As part of this, the use of response categories for each of the items was assessed. Items were rescored by merging response categories, if there was evidence to suggest that these categories were not representing the intended underlying metric, i.e. responses did not follow the predicted pattern of progressing from lower to higher scores with increasing use of a specific coping strategy. An iterative process of rescoring items or removing items and/or persons from the dataset was carried out to explore whether these modifications meant that the scale(s) conformed to the expectations of the Rasch model and could therefore be assumed to more closely represent a unidimensional, interval-level measure, whilst retaining an acceptable level of reliability (i.e., as a minimum PSI = .07 for comparing across groups and higher, closer to PSI = .09, when using the measure to assess change within an individual). The aim was to arrive at a scale or several scales that each measured one individual style of coping and that displayed psychometric properties expected of interval-level measurement.

Local dependency

In addition to this, analysis was carried out to explore whether there was an unnecessary overlap between items in the scale(s), as indicated by highly correlated residuals. If any overlap was found, an additional iterative process was carried out to explore the effects of removing one of the two items.

Differential item functioning

The impact of individual differences between respondents in the sample, including their age (working age adults vs. older adults, following a general consensus definition of persons aged 65+ years), gender (male vs. female), brain injury aetiology (traumatic vs. non-traumatic brain injury) and the study

in which they participated (study 1 vs. study 2; see 'participants' section for further details), were investigated to examine whether any of these variables were influencing responding to any of the items in the subscales. This included an assessment of the interaction between these grouping variables and level of engagement (across class-intervals) in specific ways of coping measured by each item. Following this it was considered whether items displaying differential item functioning (Rasch DIF) should be removed from the subscales.

Results

Missing data

Of the 207 responses to the CISS, 181 were complete (85% of responses collected in study 1 and 91% of responses collected in study 2). For the individual items, rates of missing responses ranged between 0 - 3.4% (M = 0.7%), with item 1 (schedule time better) receiving the least number of responses across the items.

Construct validity of the CISS

Analysis of the scale, as a whole, revealed that responses from our sample did not fit the partial credit Rasch model (χ^2 (96, N = 207) = 157.56, $p < .001$). The scale also did not display unidimensional properties. Therefore it was concluded that the CISS scale, as a whole, measured more than one style of coping. All further analysis was carried out on the properties of the measure divided into several subscales representing separate styles of coping.

Table 2 shows the item-trait interaction fit statistics, reliability indicators and results from the dimensionality analyses for the CISS. These results are presented separately for the individual subscales obtained from previous exploratory factor analyses. Only one of the subscales met the assumptions of the partial credit Rasch model, was sufficiently reliable and

were unidimensional: the Task - Short Form (Endler & Parker, 1994; χ^2 (14, N = 204) = 19.3, p = .15; PSI = .85). The Social Diversion also approached a significant fit to the Rasch model as well as being sufficiently reliable and unidimensional (Endler & Parker, 1990; χ^2 (10, N = 204) = 17.3, p = .07; PSI = .70).

********** Table 2 **********

Improving the measurement properties of the CISS subscales

Item selection

An iterative process aimed at improving the measurement properties of the three original subscales of the CISS (Emotion, Task and Avoidance) proposed by Endler and Parker (1990) was performed. The final 'best-fitting' model resulted in the following modifications. Four items (1, 6, 24 and 46) were removed from the Task subscale on the basis that responses did not conform to the pattern expected by Rasch model (these items displays fit statistics outside of the range of -2.5 to 2.5) and thus may be an unreliable source of information for measuring the construct of task-oriented coping. Similarly, five items (7, 22, 28, 33 and 34) from the Emotion subscale and one item (29) from the Avoidance subscale were removed following the same reasoning. In addition to this, qualitative feedback from participants in the sample during data collection indicated that people found it particularly difficult to respond to item 32 (go for a walk), if they were experiencing problems with mobility. A further analysis performed found that removal of this item improved the fit of the subscale to the Rasch model.

Item rescoring

A high proportion of the items in the items in the CISS (35/48) had displayed disordered thresholds, meaning that respondents found it difficult to distinguish between response categories. Items were rescored by merging indistinguishable response categories. For the Task-oriented coping subscale it was possible for one single rescoring pattern to be applied (see Table 3), while an idiosyncratic rescoring pattern was necessary for items displaying disordered thresholds in the Emotion- and Avoidance-oriented subscales (see Table 4).

********** Table 3 **********

********** Table 4 **********

Investigating DIF

An exploration of differences in responding to each individual item between male and female participants, working age and older adults, aetiological groupings and between the two different studies highlighted a couple of issues. Item 37 (phone a friend), in the Avoidance subscale, was more likely to be endorsed by females within the sample and item 4 (try to be with other people), also in the Avoidance subscale, was more likely to be endorsed by the group of working age adults as compared to the group of older adults. Despite these findings, no further improvements to the validity and reliability of the subscales resulted from removal of these items. Therefore, they were retained in the measures.

Following this process of rescoring items with disordered thresholds and removing items that did not fit the Rasch model, three modified subscales of the CISS met the assumptions of unidimensionality and interval-level measurement and were sufficiently reliable for measuring a wide range of coping strategies that were well targeted to the sample (see Figure 1 for graphs to illustrate targeting). The items included in these subscales: Task-ABI, Emotion-ABI and Avoidance-ABI, can be found in Table 3, along with specific details of fit statistics, reliability indicators and the results from the dimensionality analyses.

********** Figure 1 **********

Raw score to interval score conversion

Table 5 displays a nomogram that transforms raw scores on the three modified versions of the subscales that make up the CISS into interval-level data. For responses to the CISS without any missing data, these transformed scores can be used in parametric statistical analyses that assume data to display interval-level properties, to maximise the validity and reliability of this analysis.

********** Table 5 **********

Discussion

Rasch analysis has revealed that the CISS as a whole and several of the subscales proposed by Endler and Parker (1990, 1994) do not function as interval-level measurement scales within our sample. This suggests that we cannot rely on these scales to accurately measure how people cope following ABI. In their non-modified form, the shortened version of the original Task subscale (Endler & Parker, 1994) was the only subscale, to offer a valid and reliable indicator of coping following ABI, in accordance with IRT conceptualisation of the appropriate psychometric properties of measurement tools. The Social Diversion subscale (Endler & Parker, 1990) also demonstrated a near-fit to the Rasch model. These subscales may be useful for assessing engagement in and the impact of intervention on problem-focused coping and a specific form of avoidance. However, researchers or clinicians will not be able to draw reliable conclusions about other styles of coping, for example emotional-oriented and more general avoidance-oriented styles, on the basis of this measure as it currently stands. Research has shown that good emotional adjustment following ABI is predicted by a balance of more task-oriented coping strategies and less emotion-oriented and avoidance-oriented coping strategies (Anson & Ponsford, 2006a; Clarke & Black, 2005; Malia, Powell & Torode, 1995; Tomberg, Toomela, Pulver & Tikk, 2005), rather than the presence, or absence, of one style specifically. The current study used the results of Rasch analysis to identify invalid and unreliable subscale items, which in turn allowed modification of subscales. The resulting new subscales, in particular the Emotion and Avoidance subscales, were shown to be valid and reliable. Therefore, these modified subscales should be used to evaluate coping style following ABI in future research and in clinical case management.

The modifications we have made to the three original subscales included a number of alterations. First, items that did not contribute to measuring the construct in a meaningful way (i.e., displayed too much or too little response variation as indicated by fit residuals outside of the range ±2.5) were removed. Response patterns to specific items that were not in-keeping with the expectations of the Rasch model may be indicative of a high level of subjective interpretation, perhaps due to situational dependency, and may mean that they are an unreliable measures of a person's general coping styles. Responses which lacked variation between individuals may indicate that these items are redundant and could potentially have been influenced by a systematic response bias, such as social desirability bias in which respondents report answers that they feel are in keeping with social norms (Sánchez, Ballestros & Arnold, 2011).

In addition to removal of items that were found to be either unreliable or redundant, responses to items were rescored if the sample were unable to distinguish meaningful differences between adjacent response categories. The current sample found it extremely difficult to distinguish between more than three response categories (and even more than two response categories in some cases) for the majority of the items in the Emotion and Avoidance subscales. A significant amount of rescoring was necessary in order to arrive at more valid and reliable subscales. Response categories for the Task subscale appeared to function better. However, this finding indicates that a smaller number of response categories may be more appropriate for people with ABI. This may enhance the clarity of the measure and reduce the burden on respondents. Speed and ease of use of could be improved, thus making it a more feasible outcome measure when time-related resources are limited. This is particularly important as many people who have experienced an ABI suffer additional problems such as cognitive impairment,

communication difficulties and fatigue (see Long & Webb, 1983; and Mukherjee, Levin & Heller, 2006, for common psychological sequelae following ABI) that could influence the accuracy of assessment using self-report measures.

Rasch DIF or response biases were found for a number of items within the subscales. These response biases could be a sign that answers are being influenced by other variables specific to the group that is showing a greater likelihood of endorsing the items and could artificially inflate or reduce their scores. For instance, differences in responding to item 37 (phone a friend) from the Avoidance subscale were found between male and female participants. Female respondents were more likely to endorse this specific way of coping, independent of their general tendency to engage in avoidance-oriented coping overall. Arguably, this item could be seen as referring to coping by means of seeking social or emotional support (see 'families of coping' summarised in Skinner, Edge, Altman & Sherwood, 2003). Gender differences in the tendency to seek social or emotional support in response to stress have commonly been reported in the coping literature (e.g., Nolen-Hoeksema & Aldao, 2011; and see meta-analysis by Tamres, Janicki & Helgeson, 2002). It is possible that this tendency is influencing the extent to which this item is functioning as an accurate measure the construct of avoidance across gender groups. Item 4 (try to be with other people) also displayed DIF, but this time dependent on age group (working age vs. older adults) rather than gender. This could be interpreted as a cohort-related tendency for older adults to be more likely to seek help from others as a coping strategy (see Artistico, Cervone & Pezzuti, 2003; Folkman, Lazarus, Pimley & Novacek, 1987; Heckhausen & Baltes, 1991 for research discussing the effects of age on coping). For a heterogeneous clinical group including males and females from a range of age groups, these items may not contribute to reliably measuring style of coping. Removing these items may help to improve stability and

comparability of measurement across individuals. Further research may be needed to explore the potential influence of other variables, such as time post injury, lesion location, brain injury severity and cognitive ability, on self-reported coping style.

Exploration of the targeting of the three modified subscales to the sample revealed that all three measured a wide range of coping abilities (as displayed in Figure 1). The items on the avoidance-coping subscale were the best targeted to the population, the items in the other two subscales, particularly the emotion-oriented subscale, were slightly skewed. Future research may wish to focus on developing additional items to add to the task- and emotion-oriented subscales. Extending the range of measurement for these two subscales would potentially improve sensitivity to change.

This study left a number of additional psychometric properties of the measure unevaluated. First, stability of responses was not assessed. Participants were asked to think about how they would typically respond to a difficult, stressful or upsetting situation in relation to daily hassles rather than one specific event. They were not specifically asked to answer how they cope since experiencing an ABI, which may have had an impact on responses. In the results section it is reported that item 32 (go for a walk) was removed from the Avoidance-ABI subscale because this means of coping may have been more difficult for people who had experienced changes in mobility since their injury. However, it is possible that other items may need reviewing in future research, including qualitative feedback following clinical administration. Anecdotally, some people indicated they thought their answers would have been different if they had been asked the questions prior experiencing an ABI. Future research may also wish to assess the test-retest reliability of our modified CISS subscales.

Other psychometric properties relating to the external validity of the measure were not explored in this study either. More specifically, the convergent validity of the measure, that is, whether responses to the modified CISS subscale produced results similar to other indicators of coping style, was not investigated. In particular, it remains to be tested whether measurement using these modified subscales map on to everyday coping behaviour. Future research may wish to compare responses to these subscales with performance on behavioural tasks designed to directly observe 'online' coping behaviour, which are less dependent on memory for stressful events and awareness of how one coped with difficulties that arose (e.g. Krpan, Stuss & Anderson, 2011). This will help to establish the degree to which we can generalise from scores on the CISS subscales.

It is important to emphasise that this study only reports a validation of use of the CISS within a brain injured sample (albeit a broad community-based sample of mixed aetiologies) and that the influence of damage to specific regions of the brain was not explored. Future research may wish to focus on extending this validation work to other clinical populations, particularly for those who may be experiencing similar difficulties with cognition and communication; for example, people with intellectual disabilities, neurological conditions besides stroke and TBI, as well as severe and enduring mental health problems such as psychosis. Furthermore it is important to note that the CISS may not be an exhaustive measure of all styles of coping. Indeed, the existing literature on posttraumatic growth and adaptation (e.g., Linley & Joseph, 2004) has identified other strategies for dealing with distress. For instance some make attempts to gain greater knowledge or understanding to build meaning and develop a more positive interpretation of adverse circumstances. More passive means of dealing with difficulties may include

acceptance and/or resignation. There is scope to extend the CISS to include these further dimensions to create a more comprehensive measure of coping.

In summary, previous research indicates that coping style is an important variable moderating emotional adjustment following ABI. It is likely to continue to be a focus of research and clinical intervention and thus it is paramount that we develop measures that can accurately quantify degree of engagement in different coping style and measure change over time. The three modified subscales presented in this paper represent interval-level measurement scales that could be used to independently assess three different styles of coping amongst people who have experienced an acquired brain injury (irrespective of aetiology). This research highlights the need to be flexible in the way in which we use self-report measures, to see them as a collection of measurement points, some of which may be more accurate than others in different populations, and to adjust them accordingly. By viewing outcome measures in this way we hope to be able to improve the precision with which we measure psychological constructs such as coping style and reach a better understanding of why people act or think in certain ways in the face of adversity.

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Captions

Figure 1. Histograms of the frequency (Freq) of abilities of the persons in the sample (above the x-axis) plotted against the levels of difficulty of the thresholds for the items (below the x-axis) from a) task-oriented, b) emotion-oriented and c) avoidance-oriented coping, on a Rasch transformed scale (M=0±0.5). The mean person location for the sample are displaying the top left corner, together with their standard deviations (SD).

Table 1. Means and standard deviations for participants' age and length of time since their brain injury, overall and split by study in which the responses to the CISS were collected. IQR = Interquartile Range; TBI = Traumatic Brain Injury; NTBI = Non-Traumatic Brain Injury.

Table 2. Comparison of the construct validity and internal consistency reliability of the CISS subscales proposed in previous research. 'Best-fitting' subscales were expected to display a non-significant chi-square statistic (**Significant at the 1% level; *Significant at the 5% level), a reliability index above 0.7 and for the test of unidimensionality show a significant difference between two extreme groups of items for less than 5% of responses (†). Subscales labelled 'Distraction' and 'Social diversion' are further subscales of the 'Avoidance' subscale.

Table 3. Construct validity and internal consistency reliability statistics for the modified CISS subscales proposed in this study for use with people who have experienced an acquired brain injury (ABI). The quality of fit was established following the same criteria as described for Table

2. **Significant at the 1% level; *Significant at the 5% level; † Significant difference for test of unidimensionality.

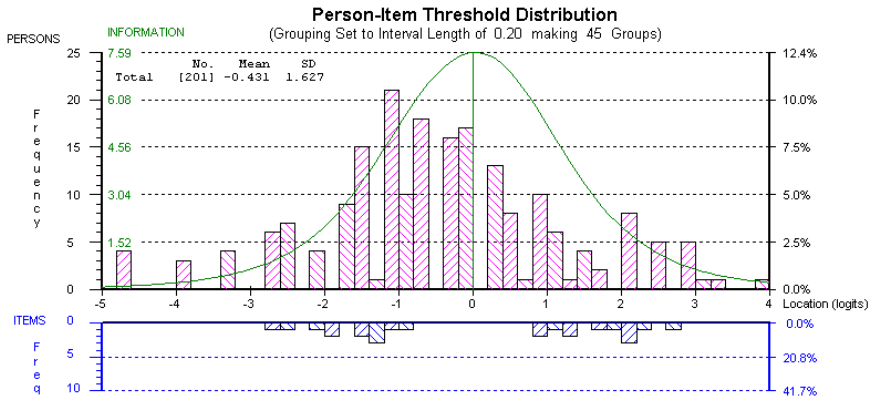
Table 4. The rescoring pattern for items displaying disordered thresholds that resulted in improvement to the measurement properties of the modified Avoidance-oriented coping scale.

Table 5. A nomogram of raw scores for the three modified subscales of the CISS transformed into an interval-level scales ranging from 0 to 100.

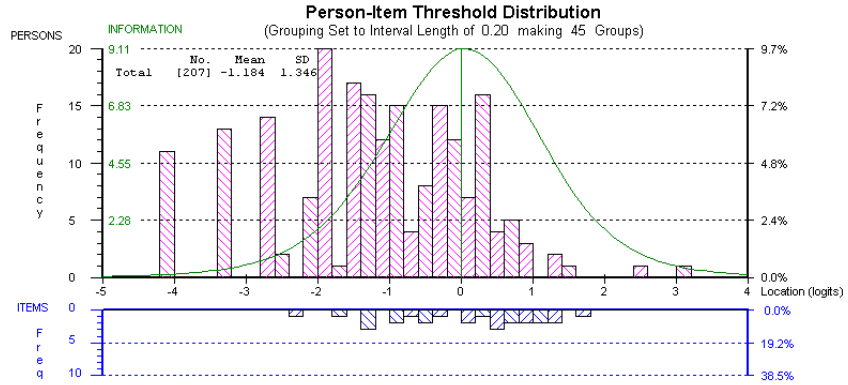
Figures

Figure 1

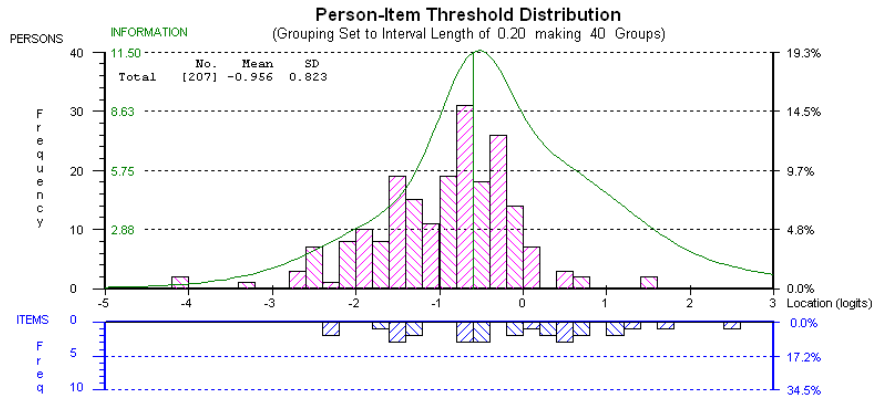
a)



b)



c)



Tables

Table 1

	Study 1	Study 2	All
Age (years)			
Mean (SD)	48 (14)	67 (15)	59 (17)
IQR	58-77	34-58	49-71
Gender			
% Male	63.6	64.0	64.8
% Female	36.4	36.0	36.2
Time since brain injury (years)			
Mean (SD)	6.2 (6.6)	2.1 (2.2)	3.8 (5.0)
IQR	0.5-3.1	1.7-7.7	0.9-4.9
Brain injury aetiology			
% NTBI	100.0	50.0	79.2
% TBI	0.0	47.7	20.8
Unknown	0.0	2.3	0.0

Table 2

Study Authors	Year published	Original sample	Subscale	Items	Item-trait interaction			Reliability	Unidimensionality	
					χ2	df	n (excluding extreme scores	PSI	Percentage of t-tests < .05	*n* (excluding extreme scores)
Endler & Parker	1990	394 (Students); 284 (Adults); 302 (Psychiatric inpatients)	Task	1, 2, 6, 10, 15, 21, 24, 26, 27, 36, 39, 41, 42, 43, 46 and 47	105.1**	32	207	.90	9.74 †	195
			Emotion	5, 7, 8, 13, 14, 16, 17, 19, 22, 25, 28, 30, 33, 34, 38 and 45	121.9**	32	204	.90	4.68	171
			Avoidance	3, 4, 9, 11, 12, 18, 20, 23, 29, 31, 32, 35, 37, 40, 44, and 48	66.7**	32	207	.80	5.52†	181
			Distraction	9, 11, 12, 18, 20, 40, 44 and 48	45.7**	16	196	.75	2.11	142
			Social Diversion	4, 29, 31, 35 and 37	17.3	10	204	.70	0.00	124
Endler & Parker	1994	394 (Students)	Task (Short form)	2, 15, 21, 24, 26, 27 and 36	19.3	14	204	.85	2.31	173
			Emotion (Short form)	8, 13, 17, 19, 22, 28 and 34	37.1**	14	199	.84	3.07	163
			Avoidance (Short-form)	12, 18, 20, 29, 31, 37 and 44	48.4**	14	202	.72	0.76	131

Table 3

Subscale	Items	Rescoring pattern	Item-trait interaction			Reliability	Unidimensionality	
			χ2	df	n (excluding extreme scores	PSI	Percentage of t-tests < .05	*n* (excluding extreme scores)
Task - ABI	2, 10, 15, 21, 26, 27, 36, 39, 41, 42, 43 and 47	Items rescored individually; see Table 4	20.8	24	201	.88	1.24	161
Emotion - ABI	5, 8, 13, 14, 16, 17, 19, 25, 30, 38 and 45	00112	34.3	26	207	.84	0.00	119
Avoidance - ABI	3, 4, 9, 11, 12, 18, 20, 23, 31, 35, 37, 40, 44 and 48	Items rescored individually; see Table 4	35.8	28	206	.70	5.85	188

Table 4

				Rescoring pattern				
Subscale	**Item no.**	**Item name**	**No. of response categories**	**0 (Not at all)**	**1**	**2**	**3**	**4 (Very much)**
Avoidance - ABI	3	Think about good times	3	0	1	1	2	2
	4	Be with others	5	0	1	2	3	4
	9	Window shop	2	0	0	0	1	1
	11	Sleep	3	0	0	1	1	2
	12	Treat myself to food	3	0	0	1	1	2
	18	Go out for food	3	0	0	1	1	2
	20	Buy myself something	3	0	0	1	1	2
	23	Go to a party	2	0	0	0	0	1
	31	See a special person	2	0	0	0	0	1
	35	Ask advice	3	0	0	1	1	2
	37	Phone friend	3	0	1	1	1	2
	40	See a movie	3	0	0	1	1	2
	44	Get away from the situation	5	0	1	2	3	4
	48	Watch TV	3	0	1	1	2	2
Emotion - ABI	5	Blame myself for procrastinating	2	0	0	0	0	1
	8	Blame myself for the situation	3	0	1	1	1	2
	13	Feel anxious about not coping	4	0	0	1	2	3
	16	Tell myself it's not happening	3	0	0	1	1	2
	17	Blame myself for being emotional	4	0	1	1	2	3
	19	Become upset	4	0	1	2	2	3
	25	'Freeze'	3	0	1	1	1	2
	28	Wish that I could change it	4	0	1	1	2	3
	38	Get angry	4	0	1	2	2	3

45	Take it out on others	3		0	1	1	1	2	

Table 5

Raw Score	Task-ABI	Emotion-ABI	Avoidance-ABI
1	0	0	0
2	9	11	9
3	16	18	16
4	20	24	21
5	24	28	24
6	28	31	27
7	31	35	30
8	34	38	32
9	37	40	34
10	40	43	36
11	43	45	38
12	47	47	40
13	50	50	42
14	53	52	44
15	56	54	46
16	59	56	48
17	62	58	49
18	66	60	51
19	69	63	53
20	72	65	55
21	76	68	58
22	80	71	60
23	84	74	62
24	91	78	65
25	100	83	68
26		90	72
27		100	76
28			81
29			89

30	100